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Enhancing Teaching Assistants' Instructional Effectiveness through Entrepreneurial Mindset: A Work-in-Progress

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Abstract

Teaching Assistants (TAs) play a critical role in undergraduate engineering education by leading laboratories, recitations, and discussion sections that directly influence student learning and success. However, many TA training programs emphasize administrative tasks rather than instructional development, leaving a gap in TA preparation. This work-in-progress study investigates how TAs perceive the usefulness and relevance of a department-specific TA training program, framed by the Kern Entrepreneurial Engineering Network (KEEN) Entrepreneurial Mindset 3Cs (Curiosity, Connections, and Creating Value), in preparing them for their instructional roles. The program consisted of an asynchronous pre-semester online course followed by an in-person workshop and was implemented within the Biomedical Engineering Department at Arizona State University. The online course addressed TA responsibilities, inclusive teaching, feedback practices, and instructional technologies through the 3Cs lens, while the workshop extended this preparation through scenario-based discussions and role-playing activities focused on common classroom situations. A pilot cohort of 15 TAs participated in the study. Likert-type items were analyzed using descriptive statistics, and open-ended responses were analyzed using thematic analysis. Results indicate that mean ratings for knowledge, teaching skills, attitudes toward TA responsibilities, and overall program quality ranged from 4.38 to 5.00 on a five-point Likert scale, suggesting strong perceived gains in confidence and clarity regarding instructional expectations. In addition, thematic analysis showed that TAs valued the 3Cs framing, opportunities to practice responding to realistic classroom scenarios, and the combination of online preparation with collaborative in-person activities. Overall, this work suggests that a 3Cs-informed, blended TA training program can enhance TAs' instructional preparation by improving clarity in role expectations and confidence in teaching practice. As a work in progress, this study offers early insights and practical strategies for engineering faculty, program chairs, and researchers seeking to mentor TAs, integrate active learning, and incorporate entrepreneurial mindset elements into engineering classrooms.

Introduction

Teaching Assistants (TAs) play a central and multifaceted role in engineering education. They serve as critical links between instructors and students and provide much of the direct instructional support in large courses [1]. TAs lead laboratory sessions, facilitate recitations, and offer individualized assistance that helps students grasp complex technical concepts, apply engineering principles, and manage demanding coursework [1]-[3]. Through regular engagement with students, TAs encourage curiosity, facilitate problem-solving, and promote participation, which enhance learning outcomes and persistence in engineering programs [4]-[6]. The TA experience also contributes to TAs' own professional growth by developing communication, leadership, and teaching skills that strengthen confidence and career readiness [6], [7]. In essence, the literature positions TAs as key contributors to instructional quality and classroom climate in engineering education, highlighting the need for structured training and professional development to ensure their effectiveness.

Despite their significant instructional responsibilities, many TA preparation programs do not sufficiently equip TAs with the pedagogical and reflective skills required for effective teaching support. Most TA training programs emphasize administrative tasks such as grading, compliance, and logistics, while offering limited attention to instructional strategies, inclusive teaching, or student engagement [8]-[11]. As a result, TAs are often assigned teaching duties without adequate preparation to facilitate collaboration, provide constructive feedback, or connect theory to practice [12], [13]. Even when formal training is available, it frequently overlooks affective dimensions such as confidence, self-efficacy, and teaching identity, which are essential for classroom presence and instructional success [14]. Prior analyses, including Carlson [15] in a study at Cornell University, indicate that TA orientations have historically emphasized policy briefings and compliance rather than interactive and practice-based learning. These limitations highlight the need to redesign TA preparation programs to prioritize pedagogical growth, reflective practice, and confidence-building experiences that enable TAs to engage students in meaningful learning.

To address these challenges, this work-in-progress (WIP) paper introduces and evaluates a targeted TA training program aimed at improving instructional effectiveness through the integration of the Entrepreneurial Mindset (EM) and the Kern Entrepreneurial Engineering Network (KEEN) 3Cs Framework of Curiosity, Connections, and Creating Value. The study is guided by the following research question:
R1: How do TAs view the usefulness and relevance of the online training course and in-person workshop in preparing them for their instructional roles?

Conceptual Framework: KEEN 3Cs of the Entrepreneurial Mindset

EM, as defined by KEEN, is a way of thinking that combines curiosity about a changing world, the ability to connect diverse ideas, and the drive to create value for others. EM is not limited to entrepreneurship but is essential for educators and engineers who want to solve real-world problems and make a positive impact [16]. EM focuses on three connected elements: Curiosity, Connections, and Creating Value [17]. *Curiosity* encourages learners to ask questions, explore ideas, and engage with complex challenges. *Connections* involve linking concepts across disciplines, applying theory to practice, and using diverse perspectives to deepen understanding [18]. *Creating Value* emphasizes applying knowledge and creativity to design outcomes that benefit individuals, organizations, and communities [19]. Together, these elements shape the design of learning experiences that promote reflection, collaboration, and application. The 3Cs framework supports activities that engage learners in exploring real-world challenges, working collaboratively, and developing meaningful solutions [19]. This approach aligns with active learning principles that promote engagement, experimentation, and reflection while strengthening critical thinking and problem-solving skills [18]. Integrating the 3Cs also supports professional growth by promoting creativity, teamwork, systems thinking, and communication, which are essential for effective teaching and modern engineering practice [20], [21]. The KEEN 3Cs Framework thus provides a foundation for developing innovative and reflective teaching practices. This framework provided the backbone for this TA training program, guiding TAs to model curiosity by asking meaningful questions, build connections by linking course content to real-world contexts, and create value by designing inclusive and engaging learning experiences that enhance student learning and classroom impact [22].

Program Description

The program was piloted within the Biomedical Engineering Department at Arizona State University (ASU) and included two components: an asynchronous online course and an in-person workshop conducted before TAs began teaching.

The Online TA Training Course

The asynchronous online TA training course was developed to prepare TAs and Instructional Aides (IAs) for their instructional roles before the start of the semester. TAs are graduate students with instructional responsibilities, while IAs are undergraduates who provide classroom support without independent teaching duties. The course included eight modules focused on compliance, Learning Management System (LMS) and technology tools, EM and pedagogy. Each module combined short readings, videos, and reflection activities that helped TAs and IAs connect ideas to real classroom situations. The course itself was not graded, but TAs enrolled in the teaching practicum course received partial academic credit for completing it. Below, we describe each of the eight modules and explain how they supported the development of instructional effectiveness and the EM.

Module 1: Roles and Responsibilities: This module introduced TAs and IAs to their instructional roles, clarifying expectations, responsibilities, and professional boundaries. It covered tasks such as leading labs, grading, holding office hours, and supporting faculty while emphasizing ethics, collaboration, and effective communication. Case-based activities helped TAs identify appropriate faculty requests and build confidence in managing classroom situations. The EM was introduced through a short video as a problem-solving approach to enhance student success, with the 3Cs illustrated through practical examples: encouraging curiosity with “why” and “what if”

questions, building connections through group activities, and creating value by showing how ideas and assignments contribute to social, economic, or environmental impact.

Module 2: Human Resources (HR) Required Trainings: This module guided TAs and IAs through onboarding and required HR trainings to help them understand university policies and employment systems. These included instructions for using Workday to complete paperwork, access payroll and professional development resources, and required trainings such as Academic Freedom Orientation, Community of Care, Graduate Violence Prevention, and safety and ethics. EM concepts were integrated by encouraging curiosity about how systems shape instructional roles, building connections between individual actions and departmental goals, and creating value through ethical and organized practices that support an inclusive learning environment.

Module 3: Canvas Learning Management System (LMS) and Learning Tools Interoperability (LTIs): This module introduced TAs and IAs to Canvas, the university's main online learning platform. It covered key tools such as SpeedGrader and Canvas Rubrics and showed how assignments, announcements, and analytics can support fair and engaging instruction. LTI tools like Gradescope for rubric-based grading and iClicker Cloud for live polling and attendance were also introduced. EM concepts were reflected through curiosity about using technology to enhance teaching, building connections between course design and engagement, and creating value through fair and inclusive learning environments.

Module 4: Creating Community: This module focused on how discussions and community building create engaging and supportive learning environments. It emphasized that inclusive, well-structured discussions allow students to share ideas, think critically, and learn from one another. Different teaching formats such as face-to-face, hybrid, and online were compared to show TAs how each supports interaction. Tools like Canvas Discussion Boards, Yellowdig, and Ed Discussion were introduced to promote reflection, participation, and collaboration. EM concepts were integrated by using discussion to inspire curiosity, build connections, and create value through inclusion and shared learning.

Module 5: Active Learning Facilitation: This module prepared TAs and IAs to design and lead active, student-centered learning experiences aligned with course goals. It introduced backward design for connecting activities to learning outcomes and guided them in writing clear objectives for labs, discussions, and recitations. Active learning strategies such as Think–Pair–Share, Muddiest Points, and real-time polling were presented to enhance engagement. The module also emphasized inclusive teaching, balanced participation, and effective feedback. EM concepts were applied by promoting curiosity through new teaching methods, building connections between content and real-world relevance, and creating value through inclusive, engaging classroom practices.

Module 6: Equitable Grading (Canvas/LTI Tools): This module introduced principles of equitable grading such as accuracy, bias resistance, and motivation, and compared traditional and inclusive practices that promote transparency and consistency. The module emphasized using rubrics aligned with learning objectives through tools like Canvas Rubrics, SpeedGrader, and Gradescope to ensure fairness and efficiency. EM concepts were integrated by encouraging curiosity about grading habits, strengthening connections between grading and course goals, and creating value through fair, consistent assessment that builds trust and supports learning.

Module 7: Crisis Intervention and Resources: This module trained TAs and IAs to recognize, respond to, and report student crises with professionalism and empathy. It explained signs of crisis such as emotional distress or academic decline and outlined steps for intervention and referral to counseling services. The Duty to Report policy was reviewed to ensure awareness of required reporting for harassment or safety concerns. EM concepts were applied by encouraging curiosity to identify signs of crisis, building connections through understanding institutional support systems, and creating value by promoting compassion, responsibility, and care in supporting student well-being.

Module 8: Module Scenarios Resource: This final module used scenario-based activities to help TAs and IAs apply what they learned about teaching, grading, inclusion, and crisis response. Each scenario presented classroom situations with multiple response options and feedback on effective, ethical choices. EM concepts were reinforced

by promoting curiosity through reflection, linking theory to practice, and creating value through actions that support learning, inclusion, and well-being.

Workshop

The workshop was designed to help TAs and IAs translate ideas from the online training course into practical teaching strategies, with a focus on discussion-based learning and active facilitation through 3Cs. It was held in person during the first weeks of the semester, lasted approximately three hours, and required completion of the online course as pre-work. The workshop began with a facilitated focus group and reflective activities in which TAs shared their positive and negative learning experiences and discussed how these experiences shaped their views of effective teaching. Interactive activities then centered on the KEEN 3Cs, where TAs examined examples of effective teaching, discussed shifts from content delivery to learning facilitation, and explored ways to encourage curiosity, connections, and value creation in the classroom. Later sessions addressed active presence, classroom management, and communication practices, including engaging students when questions receive no response, managing large-group discussions, supporting student-to-student interaction, handling repeated student emails, and setting clear communication expectations. The workshop concluded with scenario-based simulations in which TAs practiced responding to realistic situations such as silent classrooms, uneven participation, and empty office hours, and reflected on how the 3Cs can guide effective and inclusive teaching responses.

Methods

Participants

A total of 33 TAs completed the online TA training course, of whom 15 voluntarily participated in the research study. Recruitment was conducted via email using contact information provided by department course coordinators. Of these participants, 9 completed Survey 1, and all respondents were affiliated with the biomedical engineering program. Table 1 summarizes the demographic characteristics of this group, including gender, international status, graduate level, and prior teaching experience. With one exception, respondents reported no prior coursework, workshops, or formal training related to TA responsibilities or teaching practices. Survey 2 was completed by 8 participants. Demographic information was not collected in Survey 2; however, anonymous identifiers were used to pair responses across surveys, indicating that 2 of the Survey 2 respondents had also completed Survey 1.

Table 1. Participant Demographics for Survey 1 Respondents (N = 9)

Characteristic	Category	N
Gender	Male	3
	Female	5
	Not reported	1
International Status	International	3
	Non-international	5
	Not reported	1
Graduate Level	Doctoral	2
	Second-year graduate	4
	First-year graduate	3
Teaching Experience	First-time TA	4
	One semester	1
	Two semesters	2
	More than two semesters	1
	Not reported	1

Data Collection and Analysis

Data were collected through two online surveys examining TAs' perceptions of the training program and its support for developing the EM. Survey 1 was administered immediately after completion of the online course, and Survey 2 followed the in-person workshop. Both surveys included Likert-scale items (0 = Strongly Disagree, 5 = Strongly Agree) and open-ended questions. Likert-scale data were analyzed descriptively, and open-ended responses were analyzed thematically to identify recurring ideas related to the development of instructional effectiveness and the EM.

Results

Survey 1 results indicate that respondents were generally satisfied with the online training course and perceived it as helpful and relevant (Table 2, items E1-E8). Participants also reported that the training supported the development of their knowledge (Table 2, K1-K10), skills (Table 2, S1-S10), and attitudes (Table 2, A1-A5) related to applying EMAL strategies in their classrooms. All respondents strongly agreed with five items: understanding professional expectations of their role (K1), having a clear understanding of active learning (K3), feeling prepared to create discussion prompts (S3), applying grading rubrics in Canvas (S7), and providing feedback to students during class (S8). The lowest-rated item was K7 ("The reflection questions helped me connect my responsibilities to the 3Cs framework"), which ranged from somewhat agree to strongly agree.

Table 2. Results From Survey 1 After the Online Training Course

Statement	N	Min	Max	Mean	SD
K1. This training helped me better understand the professional expectations of the TA/IA role.	8	5	5	5.00	.000
K2. The online course helped me feel more prepared for my TA/IA role.	8	4	5	4.88	.354
K3. I have gained a clear understanding of active learning principles.	8	5	5	5.00	.000
K4. I can confidently describe the 3Cs of the entrepreneurially minded learning (Curiosity, Connections, Creating Value).	8	4	5	4.88	.354
K5. The training helped me understand the relationship between pedagogy and entrepreneurially minded learning.	8	4	5	4.75	.463
K6. I feel equipped to help students make connections between course content and real-world contexts.	8	4	5	4.75	.463
K7. The reflection questions helped me connect my responsibilities to the 3Cs framework.	8	3	5	4.38	.744
K8. The PlayPosit questions in the online course helped reinforce my understanding of the course content.	8	3	5	4.50	.756
K9. I feel prepared to take appropriate steps if a student discloses a sensitive issue.	8	4	5	4.75	.463
K10. I am better aware of the mental health and crisis support services available to ASU students after going through this course.	8	4	5	4.63	.518
S1. I feel prepared to use tips and tricks from the online course to increase student participation in the classroom.	8	4	5	4.88	.354
S2. I feel prepared to manage classroom time effectively during instructional activities.	8	4	5	4.88	.354
S3. I feel prepared to create discussion prompts that help students explore connections between ideas.	8	5	5	5.00	.000
S4. I feel prepared to select appropriate digital discussion tools (e.g., Canvas, Yellowdig, EdDiscussion) for class discussions.	8	4	5	4.88	.354
S5. I feel prepared to use Canvas and SpeedGrader to report grades.	8	4	5	4.88	.354
S6. I feel prepared to confidently grade by applying principles of transparent and fair assessment.	8	4	5	4.88	.354
S7. I feel prepared to apply rubrics in Canvas for consistent grading.	8	5	5	5.00	.000
S8. I feel prepared to give students clear and helpful feedback during class.	8	5	5	5.00	.000
S9. I feel prepared to intervene if there is a crisis.	7	4	5	4.71	.488
S10. I feel prepared to guide students toward mental health resources, if needed.	8	3	5	4.63	.744
A1. This training increased my motivation to work as a TA.	8	4	5	4.75	.463
A2. I now see myself as capable of implementing innovative ideas in my teaching.	8	4	5	4.88	.354

A3. I believe I can play a role in creating supportive learning environments.	8	4	5	4.88	.354
A4. The training increased my willingness to encourage student curiosity.	8	4	5	4.75	.463
A5. I see my role as helping students create value from what they learn.	8	4	5	4.88	.354
E1. The online course was clearly structured.	8	4	5	4.75	.463
E2. The course content was relevant to my role as a TA.	8	4	5	4.75	.463
E3. The scenarios helped me connect theory to practice.	8	4	5	4.75	.463
E4. The online course increased my confidence in supporting student learning.	8	4	5	4.88	.354
E5. The videos effectively demonstrated how to apply strategies in real teaching situations.	8	4	5	4.88	.354
E6. The PlayPosit questions added value to my learning experience in the online course.	8	4	5	4.75	.463
E7. The reflection prompts deepened my understanding of the 3Cs framework.	8	4	5	4.75	.463
E8. The reflection prompts made it easier to connect the 3Cs framework to actual teaching practices.	8	4	5	4.63	.518

Note. K = knowledge; S = skill; A = attitude; E = evaluation, SD = standard deviation.

The second survey, administered after the in-person workshop, received eight responses. Results indicate that respondents found the workshop reinforced concepts from the online course and considered it valuable (Table 3, WE1–WE3). Participants also reported gains in knowledge (WK1–WK4), skills (WS1–WS3), and attitudes (WA1–WA4). Mean ratings across all items were high, ranging from 4.5 to 4.88, corresponding to responses between agree and strongly agree.

Table 3. Results From Survey 2 After the In-Person Workshop

Statement	N	Min	Max	Mean	SD
WK1. The workshop helped me see how to apply Entrepreneurially Minded Active Learning (EMAL) strategies in the classroom.	8	4	5	4.50	.535
WK2. The workshop helped me identify specific strategies for applying the 3Cs (Curiosity, Connections, Creating Value) in my teaching.	8	4	5	4.88	.354
WK3. The workshop helped me understand how to design activities that promote student curiosity.	8	3	5	4.62	.744
WK4. The workshop helped me learn practical ways to help students create value from what they learn.	8	4	5	4.63	.518
WS1. The workshop helped me learn strategies to increase student participation.	8	4	5	4.88	.354
WS2. The workshop improved my ability to give students clear and helpful feedback during class.	8	4	5	4.62	.518
WS3. The workshop helped me further learn how to apply teaching strategies.	8	4	5	4.50	.535
WA1. The workshop strengthened my confidence to take on the TA role.	8	4	5	4.75	.463
WA2. I feel more confident in my role as a TA/IA after participating in the workshop.	8	3	5	4.63	.744
WA3. The workshop helped me recognize the importance of fostering curiosity, connection, and value in the classroom.	8	4	5	4.88	.354
WA4. The workshop encouraged me to think more critically about my impact on student learning.	8	4	5	4.63	.518
WE1. The workshop reinforced concepts introduced in the online course.	8	4	5	4.75	.463
WE2. I found it valuable to meet and engage in discussion with other TAs during the workshop.	8	4	5	4.88	.354
WE4. The combination of online (course) and in-person (workshop) formats enhanced my overall learning experience.	8	4	5	4.63	.518

In addition, TAs also responded to open-ended questions reflecting on their experiences with the online course and in-person workshop. Analysis of these responses revealed three primary themes: increased clarity and confidence in the TA role, development of practical and transferable teaching strategies, and a more intentional understanding of the EM. TAs described gaining a clearer understanding of professional expectations, appropriate ways to support students, and strategies for navigating common classroom situations, which contributed to greater confidence in their instructional roles. TAs also highlighted the value of concrete teaching practices, such as facilitating discussions, encouraging student participation, grading transparently, and using instructional and digital tools, noting that reflection activities and scenario-based examples helped translate ideas from the online course and workshop into real classroom practice. Many TAs also reported a shift in how they understood the EM,

moving from viewing curiosity, connections, and creating value as abstract concepts to recognizing them as actionable elements of everyday teaching.

Discussion

These findings suggest that the combined online course and in-person workshop were perceived as useful and relevant for preparing TAs. Consistent with prior research highlighting the central role of TAs in instructional quality and student engagement in engineering education [1]-[6], participants reported a clearer understanding of their responsibilities, greater confidence in teaching-related tasks, and improved ability to support student learning. These outcomes are particularly meaningful given existing literature documenting that many TA training programs emphasize administrative or compliance-focused preparation with limited attention to pedagogy and reflective practice [8]-[11]. While another similar training initiative has been reported as successful [23], our results indicate that grounding the training in the KEEN 3Cs Framework was perceived as especially valuable for the TAs. TAs described moving from viewing curiosity, connections, and creating value as abstract ideas to understanding them as actionable teaching practices, including encouraging student questioning, linking course content to real-world contexts, and designing inclusive facilitation and transparent assessment strategies. This shift reflects movement away from task-oriented support toward more intentional instructional engagement, directly addressing gaps identified in the TA preparation literature.

An additional insight relates to the design. TAs consistently emphasized the complementary roles of the asynchronous online course and the in-person workshop, noting that the combined format supported both consistency and application. The online modules provided structured preparation across topics such as roles and responsibilities, instructional technologies, equitable grading, and crisis intervention, areas often underemphasized in traditional TA preparation [8]-[11]. The in-person workshop was viewed as critical for translating these concepts into practice through reflection, discussion, and scenario-based activities. It should be noted that the study involved a relatively small number of participants from a limited set of programs, reflecting its pilot scope and limiting the extent to which the findings can be generalized. The reliance on self-reported data introduces the possibility of response bias, and the study does not yet examine how TAs' reported gains in EM-related skills influence undergraduate student learning or EM development, leaving an important linkage unexplored.

The in-person workshop also presented logistical and design challenges. TA schedules varied widely, and some were unable to attend due to hiring timelines, academic obligations, or personal constraints. In addition, designing a workshop that addressed diverse teaching contexts, experience levels, and individual needs required balancing depth with breadth, leading to necessary scaling back of content. Despite these challenges, the converging quantitative and qualitative evidence suggests that a structured, EM-informed TA training program can meaningfully support instructional development and confidence. This work provides a foundation for future iterations that could refine pacing, expand discipline-specific examples, improve accessibility, and examine longer-term impacts on undergraduate learning. Drawing on insights from this study, the project team also developed two KEEN cards documenting the online TA course and the in-person workshop as shareable resources for the Engineering Unleashed community [24], [25]. Grounded in empirical findings, these materials extend the impact of this work beyond the local context and support broader adoption of entrepreneurially minded TA training models.

Conclusion

This work suggests that a structured TA training program can strengthen TAs' instructional preparation by supporting clarity in role expectations and confidence in teaching practice. The KEEN 3Cs framework helps address pedagogical gaps. By combining an asynchronous online course with an in-person workshop, the program addressed commonly identified gaps in TA preparation related to pedagogy, reflection, and student engagement. While the findings are preliminary and based on a limited sample, they offer a promising, adaptable model for TA professional development in engineering education. Future work should explore how such training complements course-specific mentoring and examine longer-term impacts on undergraduate learning and mindset development.

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